Red Earth Engineering Pty Ltd
abn: 17 136 007 746
admin@redearthengineering.com.au
Brisbane: 108 Bowen Street, Spring Hill, QLD 4000
Phone: +61 7 3173 1714
Perth: 13/251 Adelaide Terrace Perth, WA 6000
Phone: +61 8 6118 1965

redearthengineering.com.au

Technical Memorandum

From	Waldo Dressel
To	Rhys Houlihan
Client	Karara Mining Limited
CC	Nelson Amoah
Project	J21083-KML Dry Stack TSF Review
Reference	J21083-002-TM- Dry Stack TSF Review.Docx
Date	12 October 2021

KML Dry Stack TSF Review

1.0 Introduction

Karara Mining Limited (KML) operates a Dry Stack tailings storage facility (TSF) at the Karara mine site, located approximately 225 km east of Geraldton in Western Australia.

SRK Consulting prepared a conceptual Dry Stack report in 2009 to outline the feasibility of stacking the tailings via truck dumping in a paddock style storage facility (SRK, 2009). The overall Dry Stacking concept involved either truck dumping or mechanised stacking of tailings within the TSF. KML further explored an alternative approach of using conveyors and has successfully implemented a mechanised tailings distribution and stacking system. In this approach, a mobile conveyor unit receives material from an overland conveyor and then stacks it uniformly in a radial form called Sweeps.

The Dry Stack TSF designed by Wave International (2015) supersedes the SRK (2009) design and includes four ~25 m high lifts, up to a maximum RL 430.0 m (AHD). The first lift, which is in progress at RL 354.0 m (AHD), will be stacked in separate radial 'sweeps' based on the revised sweep plan prepared by Bis Industries in 2014.

Tailings dry stacking commenced during the initial stages of the operation in 2013. **Figure A** shows the location and layout of the existing Dry Stack and Wet TSFs at the site.

Wet TSF 1 is located inside the approved area of the Dry Stack TSF, south of the Sweep 2 area and deposition into the Wet TSF 1 was completed in early August 2018. Wet TSF 2A is the current operational Wet TSF, and construction was completed in 2018. The Wet TSF 2A was designed as a single cell. It was changed by constructing a low temporary dividing wall to allow for early wet tailings deposition in Cell 1 prior to completion of the construction of the entire Wet TSF 2A. The wet tailings deposition has now exceeded the height of the temporarily dividing embankment, so the TSF is now operated as a single cell, as per the original design intent.

A proposed new Wet TSF 2B is planned to extend to the north of the Wet TSF 2A, to increase KML's Wet tailings storage capacity.

KML intends to revise the Dry Stack TSF sweep areas to extend further south and east of the original Dry Stack TSF footprint. This memorandum summarised the review of the revised Dry Stack TSF footprint area and is based on KML's mine plan, producing 12 Mtpa dry stacked tailings over the next 35 years.

The proposed footprint for each vertical lift has been modelled in 3D to estimate the storage volume capacity per lift. It should be noted that REE has not modelled individual sweeps as part of this scope of work, and it can be done in future if required by KML.

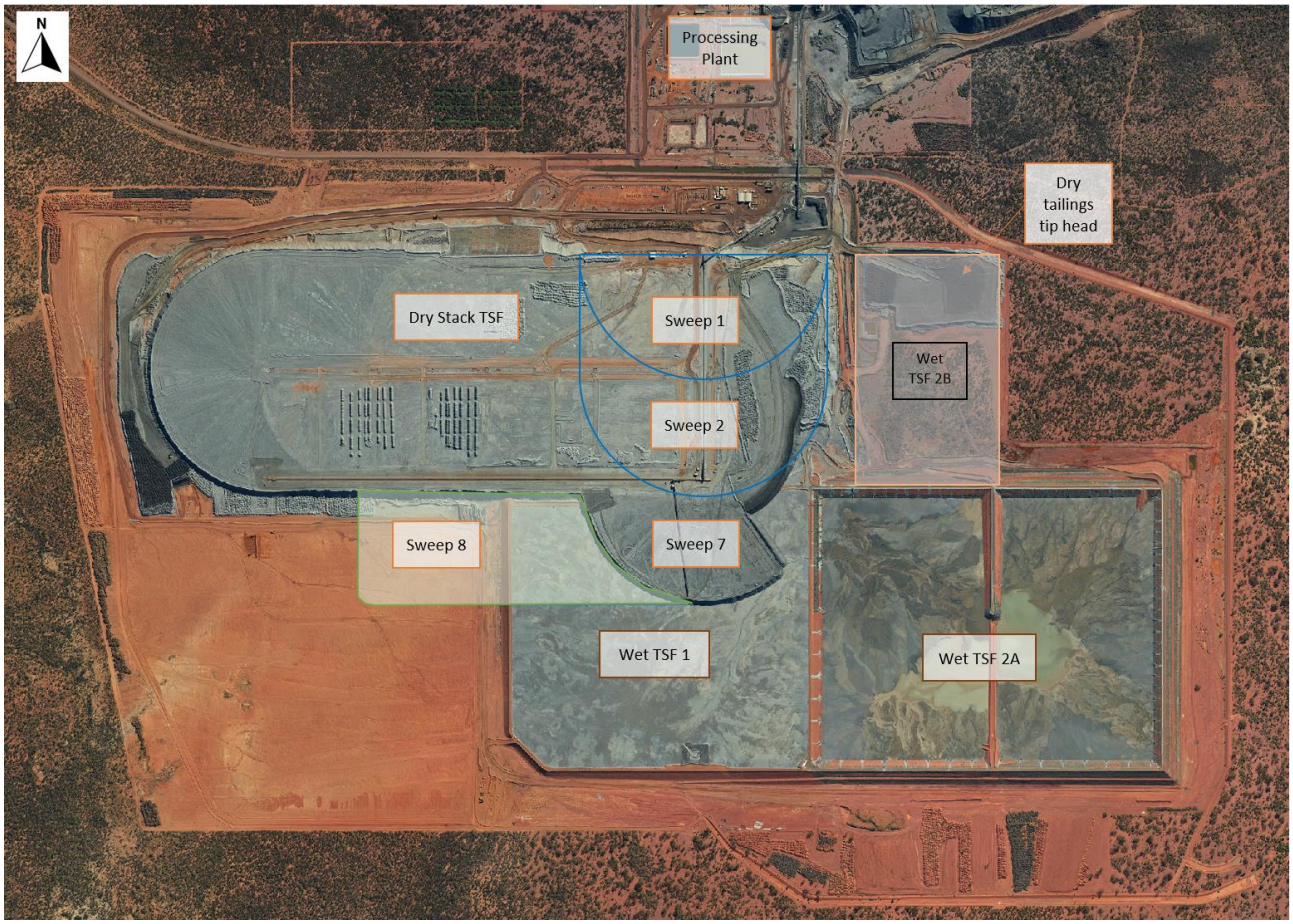

Figure A: Location and layout of existing TSFs and proposed Wet TSF 2B (July 2020)

2.0 Capacity Review

The sweep layout and design carried out by Wave International (2015), included four vertical lifts to a final elevation of RL 430.0 m, see **Figure B**. Wave International (2015) recommended maximum vertical lift heights of 26 m for Lift 2 and Lift 3. REE reviewed the lift heights, and a maximum vertical lift height of 24 m was used as part of this assessment, see **Figure C**. REE also reviewed the final number of lifts required to allow storage of filtered tailings over the proposed 35 years life of mine.

The capacity assessment for the Dry Stack TSF was undertaken assuming that Wet TSF 2A and Wet TSF 2B are filled with tailings to their maximum design capacity, i.e. tailings levels 0.5 m below the perimeter embankments.

The following parameters were used for the capacity assessment of the Dry Stack TSF:

- An average in-situ dry density of 1.7 t/m^3, based on observations during the current dry stacking operations, in-situ testing and laboratory testing on undisturbed samples from the Dry Stack (Golder 2019). This is considered conservative, as the dry density measured by Golder (2019) on undisturbed samples retrieved from the Dry Stack ranged from 1.8 to 1.9 t/m^3.
- Dry tailings production rate of 12 million tonnes per annum.
- Life of mine of 35 years.
- Outer slope of dry stacked tailings at 35 degrees. This is conservative as it has been observed during existing operations that the stacking angle varies from 43 to 45 degrees.

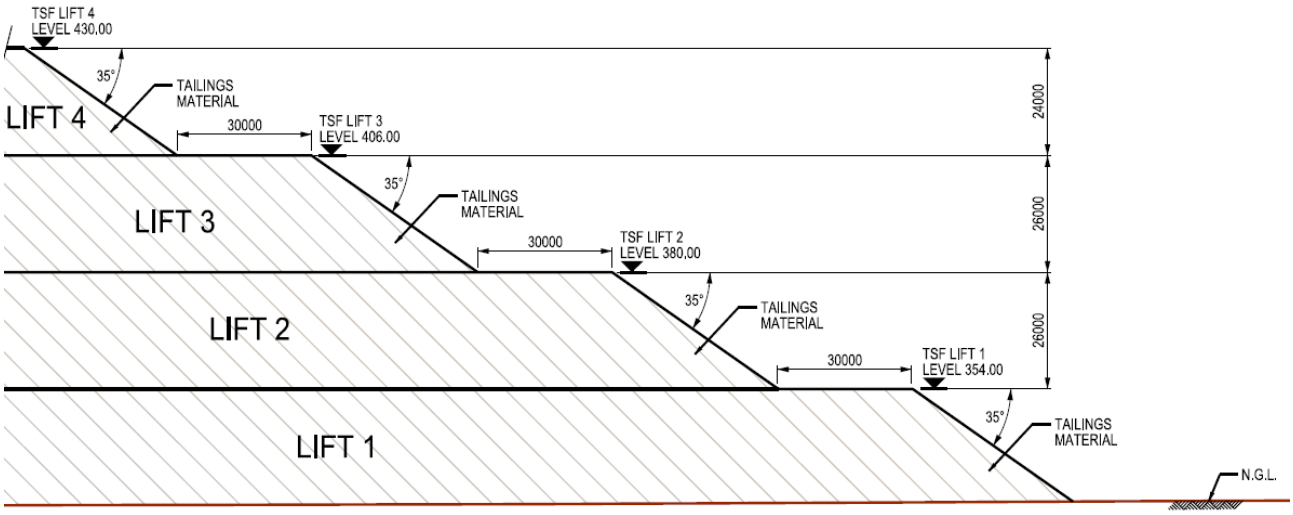

Figure B: Dry Stack TSF Typical Section (Wave International 2015)

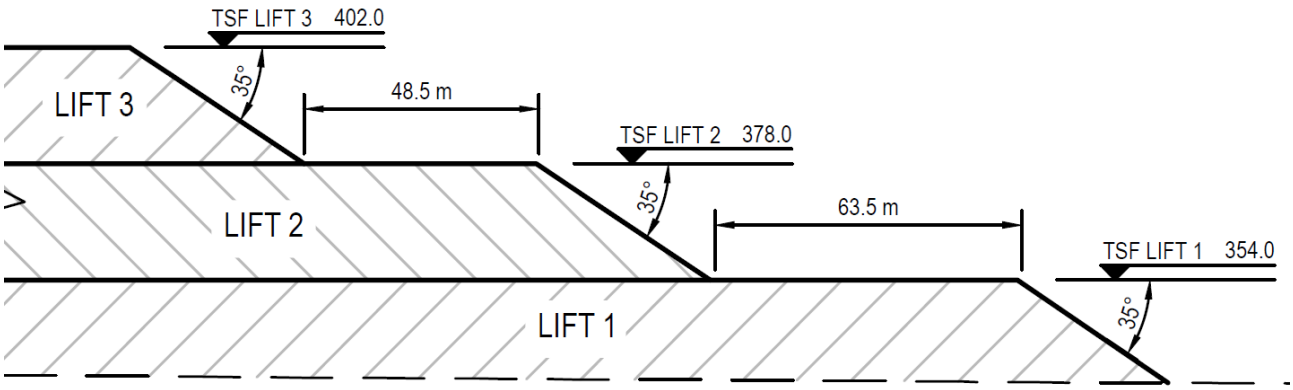

Figure C: Dry Stack TSF Typical Section (REE 2021)

Table 1: Dry Stack TSF Capacity Review

Lift	Storage Capacity (m^3)	Cumulative Capacity (m^3)	Stored Tonnage	Stored Cumulative Tonnage	Fill Time (years)	Cumulative Fill Time (years)
Lift 1 (L 354)	124,540,000	124,540,000	211,718,000	211,718,000	10.4	10.4
Lift 2 (RL 378)	175,030,000	299,570,000	297,551,000	509,269,000	14.6	25.0
Lift 3 (RL 402)	150,020,000	449,590,000	255,034,000	764,303,000	12.5	37.5

3.0 Dry Stack TSF Layout

The Dry Stack TSF general layout was updated based on the revised footprint. The layout provides a conceptual indication of clean surface water diversion drains required around the facility (see Figure 1, **Attachment 1**). Stantec (2020) has been appointed by KML to assess the surface water hydrology for the site, including the Dry Stack TSF area, and REE has not provided any recommendations for the design (sizing) of future surface water diversion drains around the Dry Stack TSF.

Allowance has been made for an area to the south and southeast of the Dry Stack TSF to store vegetation and topsoil stripped from the Dry Stack TSF footprint (see Figure 1, **Attachment 1**). The future clearing areas required based on the July 2020 aerial image of the site (provided by KML) indicates a clearing area of 450 ha, and if the topsoil is stripped to a nominal depth of 150 mm, the topsoil volume to be stored is 675,000 m^3. The demarcated topsoil and vegetation stockpile area covers an area of 170 ha (see Figure 1, **Attachment 1**).

3.1 Hydrology

REE has made allowance for a retention pond at the southeast corner of the Dry Stack TSF area. The intent is to construct a small retention pond to capture sediment-laden runoff within the Dry Stack TSF catchment area. KML is currently managing surface runoff water from a sump located at the north-eastern corner of Wet TSF 2A, from where water is returned to the Processing Plant for use in processing.

Very low runoff has been observed from the Dry Stack TSF since the commissioning of the facility. Studies have been undertaken over the years to examine the geotechnical parameters and behaviour of the filtered tailings deposited at the Dry Stack TSF. It includes the effects of surface water infiltration and the potential for the Dry Stack to develop saturated conditions, particularly after heavy rainfall events and during the winter rainfall months.

The following are some of the operational reasons why there is minimal runoff from the Dry Stack surface:

- The general surface readily absorbs surface water through higher permeability areas, and ponded water trapped within the surface undulations infiltrates into the Dry Stack tailings mass. Surface water is also removed due to very high evaporation rates, even in the winter months.
- The infiltration rates in the upper surface of the Dry Stack are enhanced due to the development of surface cracks that increases the overall bulk permeability of the Dry Stack, at least at the near-surface (within upper 1 m depth).
- The outer 10 m width around the edges of the Dry Stack surface are very loose and allows any additional water runoff from the surface to quickly infiltrate into the loose materials with relatively high permeability. Water ponding is not allowed along the edges and close to the safety windrows or within 40 m from the windrows (see **Figure D**).
- The outer 5 m width around the edges of the Dry Stack surface have mandatory 2 m high safety windrows, which provides total containment of surface water within the Dry Stack upper surface area.
- Over the past 7 years of full operation of the Dry Stack TSF, no seepage has been observed around the toe at any time (winter or summer), even with full surface water containment.

The filtered tailings deposited in an unsaturated state has unique and advantageous hydrological properties that allow infiltration and total surface water containment without the potential formation of a phreatic surface that can potentially compromise the geotechnical stability of the facility.

In practice, the runoff coefficient from the surface is near zero, and a conservative coefficient of around 0.1 is recommended for any hydrological modelling purposes.

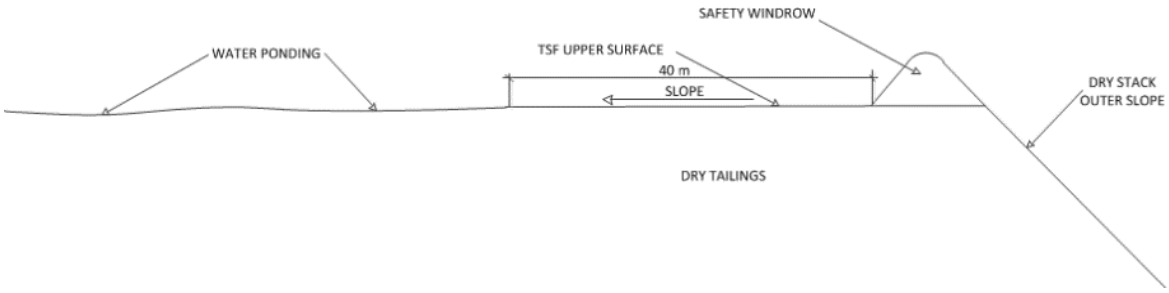

Figure D: Water Management against Outer Slope of Dry Stack TSF

4.0 Rehabilitation and Closure

REE modelled the final geometry of the Dry Stack TSF to represent the reshaped TSF as per KML's requirements for rehabilitation and closure (see Figure 3 and Figure 4, **Attachment 1**). The revised Dry Stack TSF has been designed to be stacked in three lifts with a maximum average height reaching 60 m.

The rehabilitated outer slopes of the Dry Stack TSF are planned to be reshaped to 18-degree slopes and 5 m wide benches with 10% back slopes. Benches are included nominally at 24 m vertically. A 1 m high berm has been placed on the outer side of the bench for stormwater management, see **Figure E**.

Topsoil/banded-iron formation (BIF) rock mixture (2:1 mix ratio) is proposed over the Dry Stack TSF rehabilitated slopes to a minimum depth of 300 mm. Placement of bunds along the top of the TSF at closure will also allow for water to be retained near source and minimise runoff down-slope.

KML is carrying out rehabilitation trials along the northern slope of Lift 1 of the Dry Sack TSF. It is understood that such rehabilitation trials will progress over the years, and the outcomes from the trials will inform the closure design. This will provide a good basis for arriving at appropriate closure criteria for the Dry Stack TSF.

The specific methodology and rehabilitation associated with the Dry Stack TSF are detailed in KML's Environmental Procedure – Land Rehabilitation (CORP-EN-PRO-1002).

It must be noted that surface water drainage systems should be designed to meet the acceptable rainfall event. In the case of closure, it is recommended that all surface water runoff drainage structures, associated with the Dry Stack TSF, must be designed appropriately for Probable Maximum Precipitation (PMP) event.

A comprehensive geotechnical assessment of the Dry Stack TSF should be undertaken to confirm the long-term geotechnical stability of the structure before undertaking the final closure design and rehabilitation works.

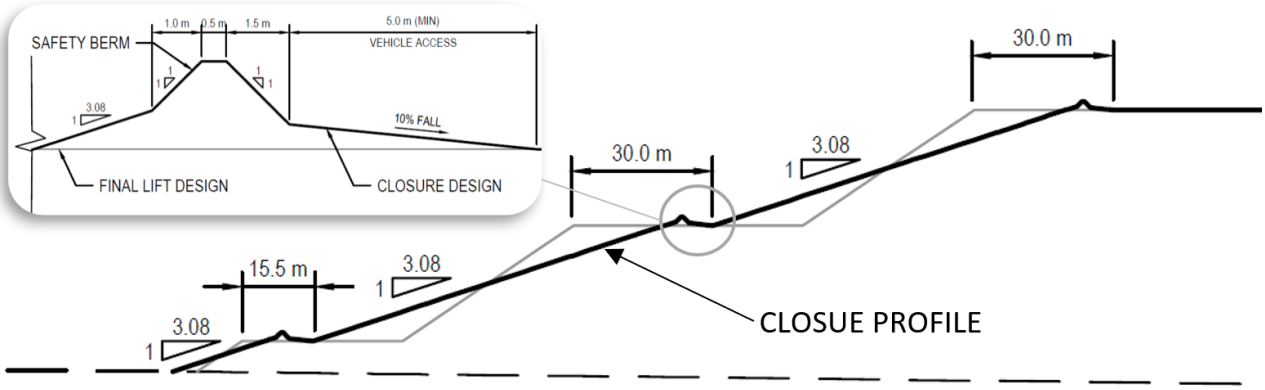

Figure E: Dry Stack TSF Typical Section – closure profile

5.0 References

Golder Associates Pty Ltd (August 2019). Dry Stack TSF and Temporary Wet TSF Investigation and Geotechnical Stability Analyses, Ref. 1896382-001-R-Rev0.

SRK Consulting (July 2009). 'Karara Project Western Australia, Tailings Storage Facility Design Report' (KAR002).

Stantec (December 2020). Karara Iron Ore Project and Mungada Iron Ore Project - Surface Water Hydrology Assessment (Revision B).

Wave International (July 2015). Dry Stack Tailings Storage Facility Design Report.

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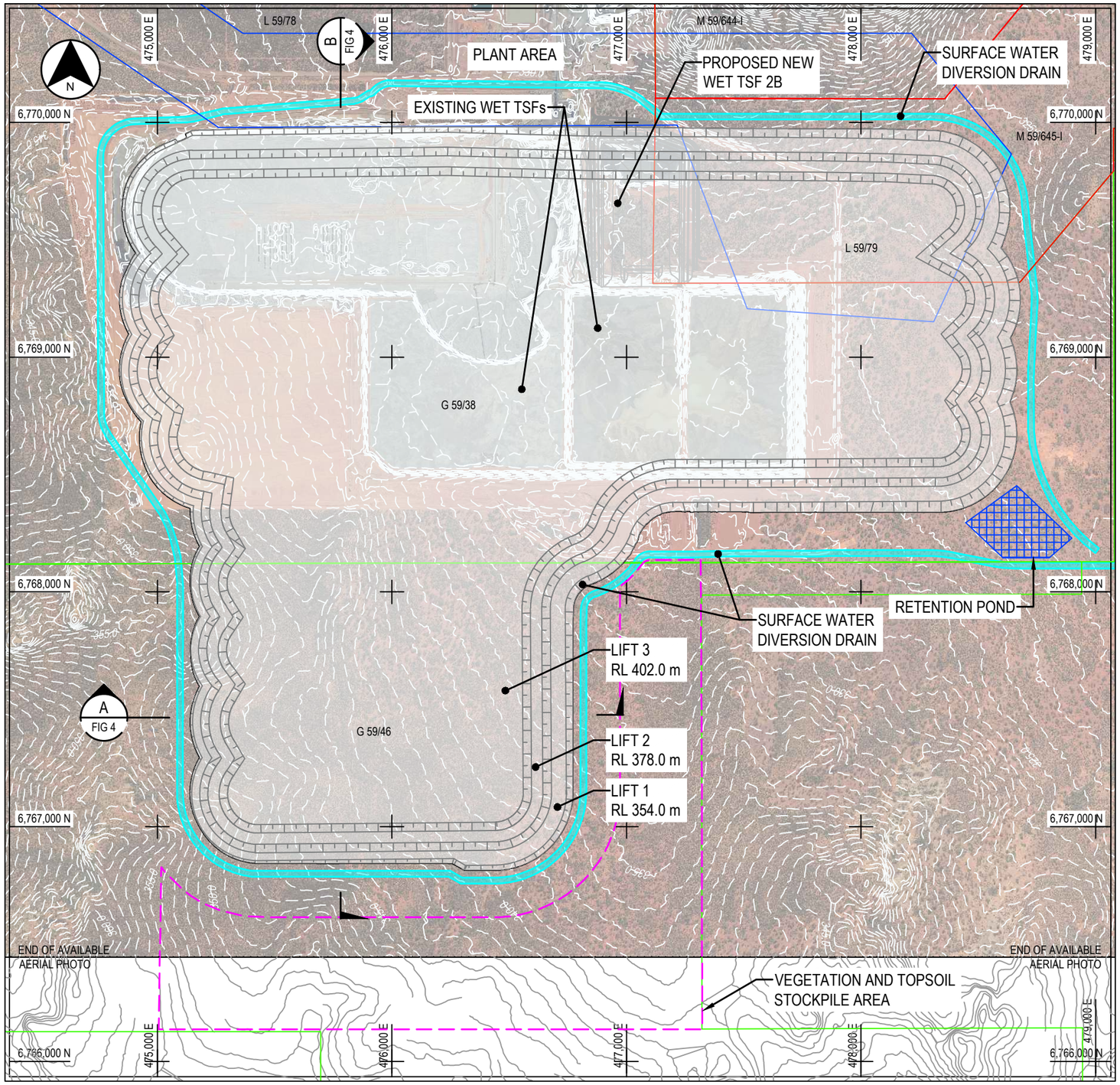
Attachment 1
Figures - Dry Stack TSF



SITE LAYOUT
SCALE 1:20,000

TSF LIFT VOLUMES	
LIFTS	VOLUMES (m³)
LIFT 1	124,540,000
LIFT 2	175,030,000
LIFT 3	150,020,000
TOTAL	449,590,000
ASSUMPTIONS: TAILINGS IN-SITU DRY DENSITY 1700 kg/m³	

KML TENEMENTS:

- MINING LEASE
- GENERAL PURPOSE LEASE
- MISCELLANEOUS LICENCE

NOTES:

1. AERIAL IMAGE SUPPLIED BY KARARA MINING LIMITED
2. EXISTING CONTOURS ARE BASED ON SURVEY SUPPLIED BY KARARA MINING LMITED DATED 2020
3. SWEEP DESIGN BY OTHERS

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SCALE 1 : 20,000

KARARA MINE IRON ORE PROJECT
DRY STACK TSF REVIEW
LIFTS 1-3 SITE LAYOUT

Rev A
Figure No.
FIGURE 1

Project No. J21083
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Date: 20 September 2021
Datum: MGA 94 ZONE 50, AHD
Revision: A Draft - Issued For Client Review

KARARA MINING LTD

Red Earth Engineering Pty Ltd
ABN: 17 136 007 746
Phone: +61 8 6118 1965
admin@redearthengineering.com.au
L13, 251 Adelaide Terrace, Perth WA 6000

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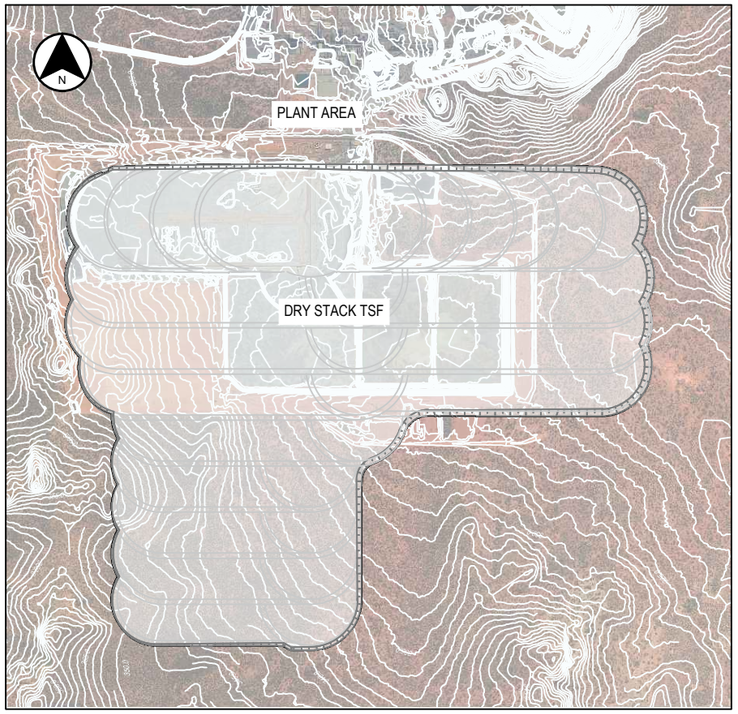

LIFT 1 - LAYOUT PLAN
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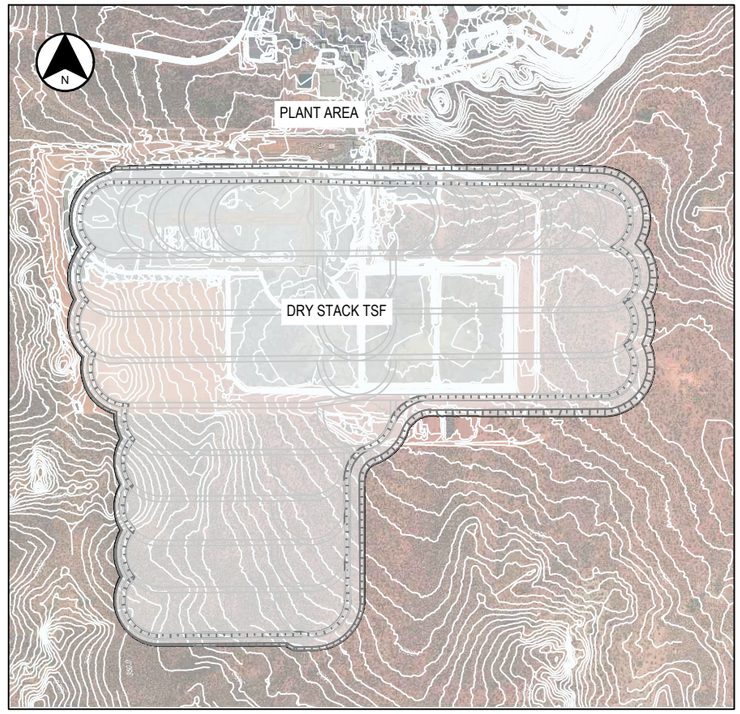

LIFT 2 - LAYOUT PLAN
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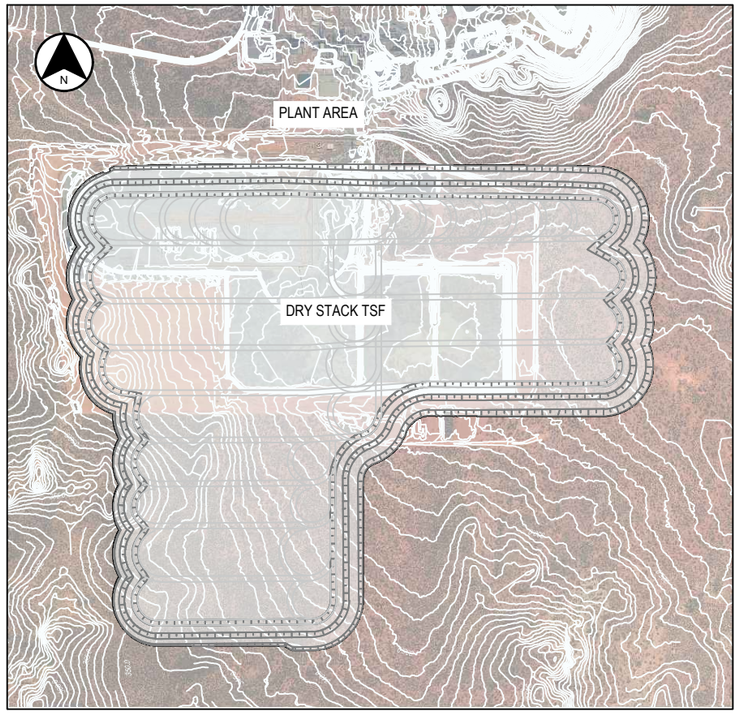

LIFT 3 - LAYOUT PLAN
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KARARA MINE IRON ORE PROJECT

DRY STACK TSF REVIEW
LIFTS 1-3 LAYOUT PLANS

Rev A | Figure No. FIGURE 2

A3

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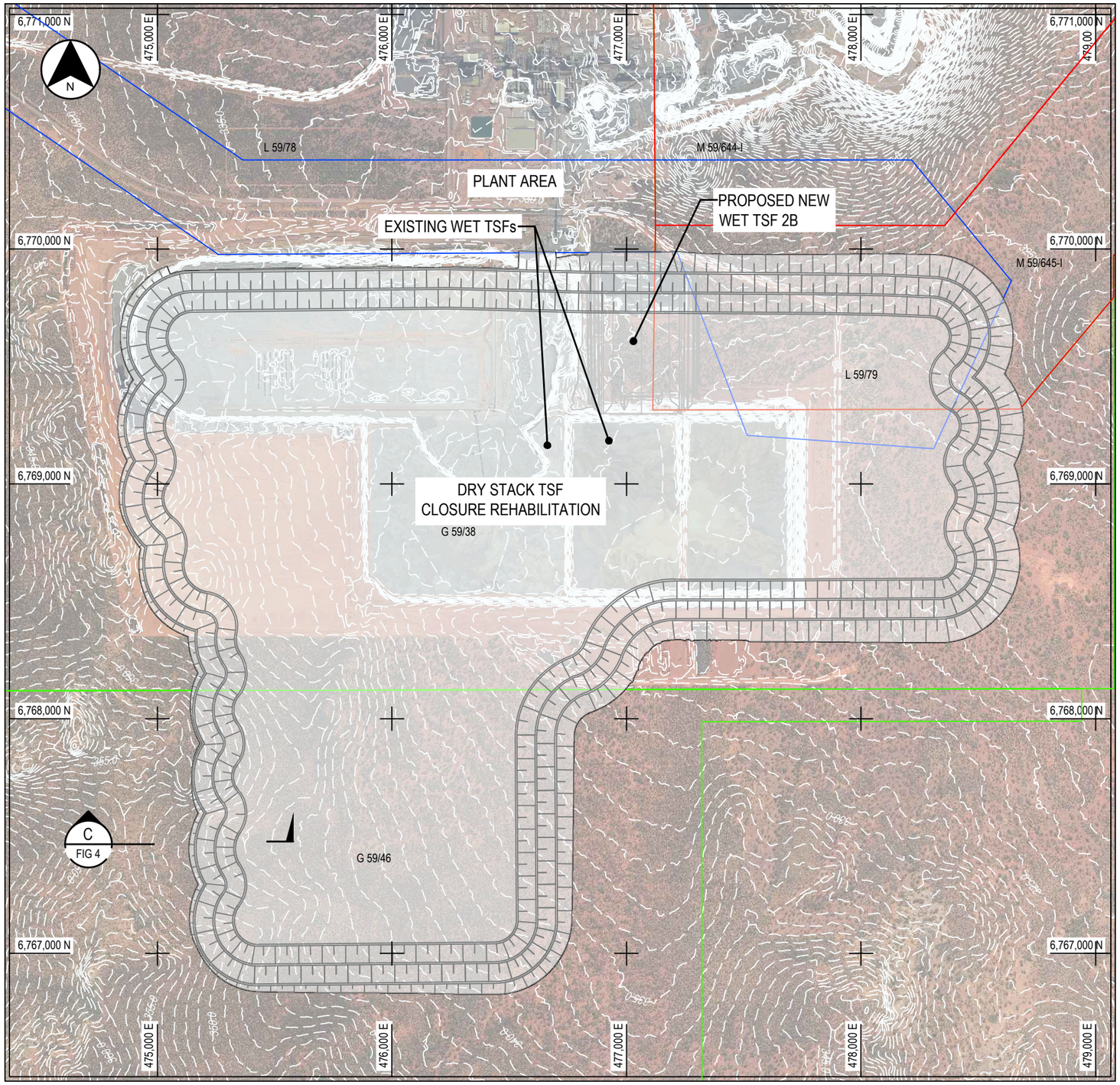
KARARA MINING LTD

Red Earth Engineering Pty Ltd
ABN: 17 136 007 746
Phone: +61 8 6118 1965
admin@redearthengineering.com.au
L13, 251 Adelaide Terrace, Perth WA 6000



CLOSURE LAYOUT
SCALE 1:20,000

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KARARA MINE IRON ORE PROJECT

DRY STACK TSF REVIEW
CLOSURE LAYOUT

Rev A | Figure No. FIGURE 3

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Red Earth Engineering Pty Ltd
ABN: 17 136 007 746
Phone: +61 8 6118 1965
admin@redearthengineering.com.au
L13, 251 Adelaide Terrace, Perth WA 6000

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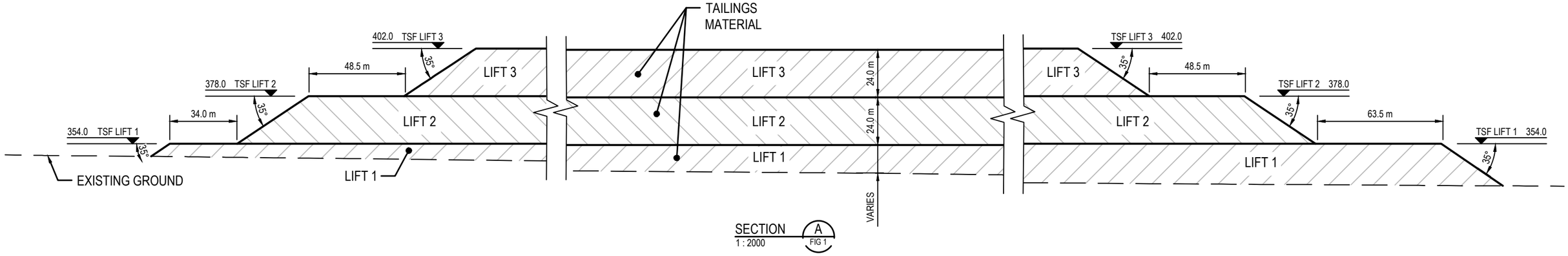

SECTION A
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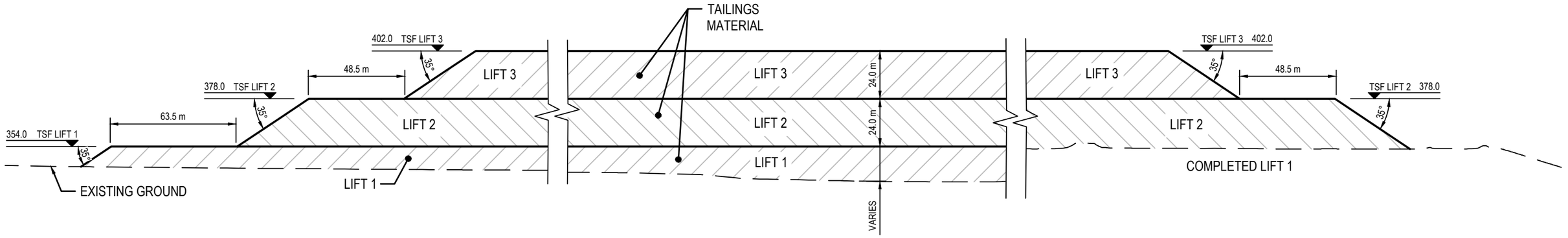

SECTION B
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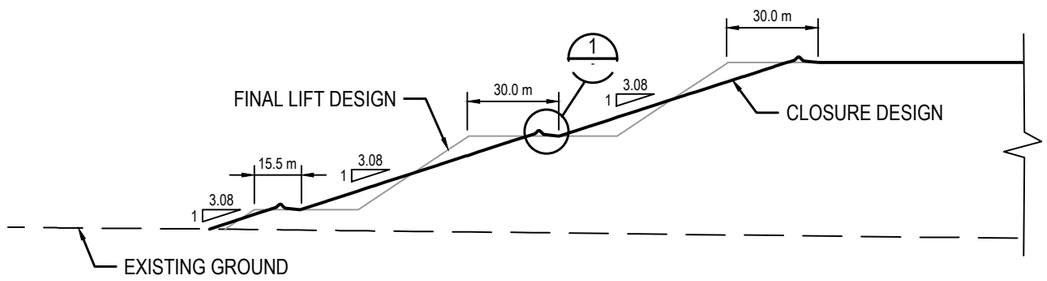

SECTION C
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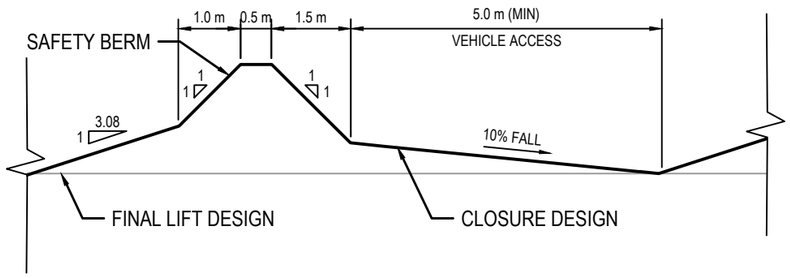

DETAIL 1
1 : 100

NOTES:

1. ALL DIMENSIONS IN METRES (m) UNLESS NOTED OTHERWISE
2. SURVEY SUPPLIED BY KARARA MINING LMITED DATED 2020
3. TOPSOIL/BANDED-IRON FORMATION (BIF) ROCK MIXTURE (2:1 MIX) TO BE PLACED OVER THE DRY STACK TSF REHABILITATED SLOPES TO A TOTAL DEPTH OF 300 mm

0 1 2 3 4 5
SCALE 1 : 100

0 20 40 60 80 100
SCALE 1 : 2,000

KARARA MINE IRON ORE PROJECT

DRY STACK TSF REVIEW
SECTIONS AND DETAILS

Rev A | Figure No. FIGURE 4

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KARARA MINING LTD

Red Earth Engineering Pty Ltd
ABN: 17 136 007 746
Phone: +61 8 6118 1965
admin@redearthengineering.com.au
L13, 251 Adelaide Terrace, Perth WA 6000

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